By G8MNY (Updated Dec 14)
(8 Bit ASCII graphics use code page 437 or 850, Terminal Font)

A few years ago I bought several of these BHI NES LS, after reading the Dec 2002 Radcom Article by G4HCL, & hearing one actually demonstrated at a rally. The demo is what really sold it to me. I also went to a ham club where 1 of the 3 man company, gave a talk on it's development & the trials & tribulations of getting the product out. It was interesting to learn that the dedicated IC used was designed for noise elimination on fitted car phone microphones & not on Rx noise, & it has now gone out of production in favour of an improved IC.

The units have quite amazing performance, compared to other DSP types, don't be fooled by the little amplified speaker box & it's relatively high cost, it really is the state of the art surface mount 64 pin Digital Signal Processing noise reduction unit running at 16MHz. Other models & PCB rig upgrades not tested by me, but I assume they are much the same & based on the same IC.

```
        On Off    Volume
          n         n                        n          n
    /~~~~~~~~~~~~~~~~~~~~~\            /~~~~~~~~~~~~~~~~~~~~~\
   │                   LED │       Ext│                       │
▯ ││                       ││▯      LS│        Level      DC  │
▯ ││     Loud Speaker      ││▯        │ I/P     DIL       (¨) │
▯ ││                       ││▯        │ Lead o  """"          │
  ││                       ││         │                       │
  │ \_____________________/ │          \_____________________/
  └─────────────────────────┘                    REAR
```

It has 8 levels of noise reduction set up on the rear DIL switch, as well as an input volume control (does same as Rig Volume!) & a noise reduction on/off switch that also lights a red/green LED visible through the speaker grill. The unit is powered by the usual 2.3mm DC connector (+ in the middle) & it has a series idiot diode for protection as well as a 12V regulator. In the OFF mode the unit is just an amplified speaker, with the time delay, frequency response & input impedance seen below. In the ON mode there is software AGC as well as the effective noise & tone eliminating function.

Here are some performance figures I measured from my one...

AUTOMATIC NOISE & TONE REDUCTION

DIL SETTING	SSB NOISE *	1kHz TONE	COMMENTS
1 Min	9 dB	4 dB	Best no DSP artefacts setting
2	11 dB	5 dB	
3	12 dB	6 dB	Best all round SSB setting
4	13 dB	8 dB	
5	16 dB	16 dB	
6	19 dB	21 dB	
7	24 dB	25 dB	
8 Max	33 dB	65 dB	Hi artefacts, no squelch needed mode.

* Noise & Tones was measured on a flat averaging analogue meter.

As with all DSPs, as the wanted Signal gets close to the noise level in its narrow digital samples the unit makes more errors trying to remove the noise.

At setting 8 MAX there is no need to use a SQUELCH on FM, in fact a chopping squelch is unhelpful as the DSP retraining time for the noise change causes the noise to jumps on & fade off. The only problem using it at max under noisy conditions, is knowing when an over has occurred as you are left with almost silence, just the DSP remnants musical tones peaking at -33dB.

FREQUENCY RESPONSE (external Hi Z connections) 25Hz - 4.5KHz @ -3dB. Which makes it quite acceptable for non HiFi Broadcast Radio signals. A bigger external LS is needed to hear any bass!

INPUT IMPEDANCE is 10k Ohms. (20k on cheaper model)

TIME DELAY was 27mS, which I guess is the time to go from Analogue to Digital & back to Analogue.

In the off mode the audio still goes Analogue-Digital-Analogue but without any noise processing, you still get the frequency filtering due to the 12kHz sample rate, e.g. a 6kHz turnover frequency & filtering that gives -3dB @ 4.5kHz. The processor clocks at 16MHz. Higher clock rates (I tested up to 55MHz) give proportional higher frequency responses, but after about 32MHz (-3dB @9MHz) much of the improvement was lost in unwanted musical effects.

IN USE
I found that you soon get used to the musical artefacts (like digital phones) that the highest level of DSP gives you on very noise signals, as these are much preferred to normal very noisy audio. At moderate eliminating levels, moderate noise reduction occurs & the recovered speech is more like normal. With extremely noisy weak signals (0dB S/N) the recovery process starts to fail & little usable audio comes though, at these levels straining with the normal signal MAY JUST be better.

The tone reduction feature may be of specific interest to HF/VHF operators who have computer birdies etc. on channel. This unit can automatically eliminate carriers by up to 65dB if needed in under a couple of seconds, allowing weaker Dx to be worked underneath, although the tone will slightly reappear on speech peaks or changing noise floor.

There is a software AF AGC both on processing & non processing modes so too loud a level with cause this to give the odd "click" on heavy AGC action.

ON CW as long as the wanted signal is stronger than others in the Rx passband normal CW will be heard totally noise free. Slow Morse having longer than 1 sec CW elements will be attenuated are the DSP action tries to remove it. Also strong signals may have clicky starts again as the DSP gets it wrong.

ON AM/SSB/FM there is little difference in the audio quality just much reduced background noise. With music, there is a tendency to eliminate all but the loudest instruments.

WITH TV SOUND
On sports commentary, the background crowd noise is well reduced, making the commentator's voice stand out rather than be drowned out, something deaf people may find very useful. For HIFI use I did try higher clocks up to 55MHz where it gave flat response to 15kHz, but the artefacts became quite noticeable. However with 32MHz clock a reasonable 9kHz treble compromise sounded OK to me.

HAM ATV SOUND
I have to listen to several channels at a time when using 23cms ATV repeater GB3HV :- 144.75 FM talkback locally, 5.5MHz subcarrier carrying Engineering sound 144.75 Rx @ GB3HV, as well as 6MHz subcarrier HiFi Sound. So using several of the cheaper NES boxes is a option for me.

THE PROBLEMS

My main gripe with the unit is the use of a tiny DIL switch to control the depth of noise reduction. Although the maker suggest most people leave this set at level (cheaper model). This should really have been a easy access BCD switch as off mode is useful in tuning in SSB. I have done this modification to the cheaper model, as well as increased the 100uF LS cap to 470uF & made the unit operate as a dumb LS when there is no power.

Other problems are slight RFI from the unit if used close to your Rx aerial, (e.g. when using Handhelds). And it has slight susceptibility to alternator whine when /M on Tx, this is down to the series diode & 12V reg not doing anything as there is no voltage headroom!

Also be aware when running from same PSU as HF rig, as a few mV drop on rig earth lead, will appear in LS input lead & sound like Tx RFI in the LS. In that case try no PSU earth to LS, only LS earth from rig.

For more information on the unit see www.bhinstruments.co.uk or see the RADCOM article.

(P.S. I have no commercial interest in this product/co, this is just my)
(personal experiences of these units, that I hope others may be interested in.)

MY MODIFICATIONS

Five modifications can all be done to the cheapest unit WITHOUT the on off processing switch, DIL processing level preset switch or volume control.

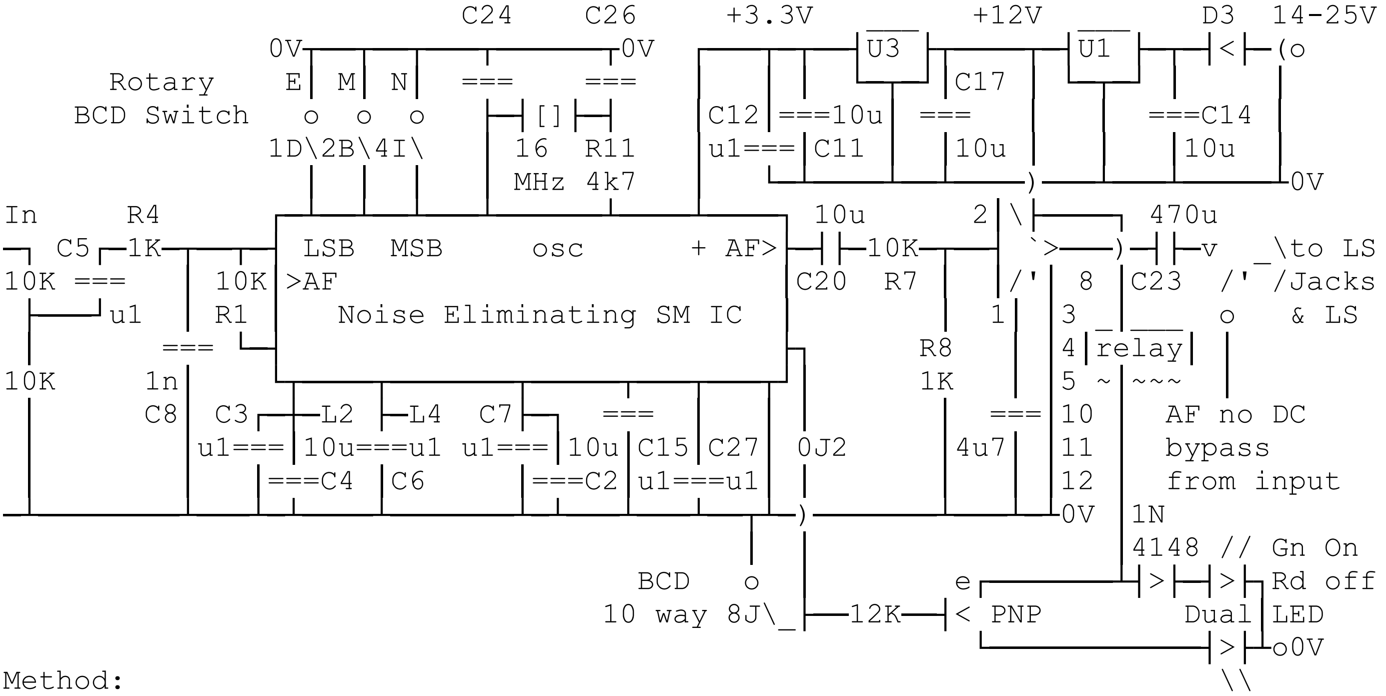
A/ Add centre speaker 10 way noise processing level & in/out control switch.
B/ Add dual Green ON & Red through mode dual LED.
C/ Add no power LS only mode (uses a DIL relay).
D/ Improve LF LS output, change 100u for 470u.
E/ Add 2 External LS sockets, one with switched LS.

```
 /~~~~~~~~~~~~~~~~~~~~~\
|        3 2 1      LED|Switched Ext LS jack
|      4 /~~~\Min      |
|        |   |         |
|      5 \___/Out      |
|        6 7  Max      |Unswitched Ext LS jack (e.g. H/Phone)
 \_____________________/
```

Tools needed: 10mm Punch (10mm drill body & a metal hole)
LED & 3.5mm Jack holes can be made with soldering iron/drill.
Anti Static earthed soldering iron.
Use Anti Static handling precautions.

Parts Needed:
BCD 10 position switch (RS cat 327-938)
Small shrouded skirt knob.
15cm of 5 way coloured ribbon wire.
Dil 11V C/O reed Relay, & metal screen.
Dual colour LED (-ve common).
Small PNP transistor.
2x 3.5mm surface mounting jack socket.
Small 470uF 10V cap.
Several colours of thin connecting wire.

DIAGRAM OF A MODIFIED UNIT



Method:

1/ Remove the warranty label, these mods will invalidate it anyway!

2/ Unscrew case & carefully remove LS & PCB.

3/ Remove front Grill & cloth, punch out central switch hole in grill & cloth.

4/ Cut off switch legs to not foul speaker. With a hot iron quickly wire up the switch tag remains to the ribbon, forming the ribbon from next to the grill. brown-D, red-B, orange-I, yellow-J, green-E-F-M

5/ Make LED whole in top RH corner of plastic baffle (in one of the moulding weakness), & make hole for LED common to go to green switch common & wire up.

6/ Make ribbon recess slot in LS baffle bottom, reassemble LS front checking LS is not fouled, glue ribbon into slot.

7/ Wire ribbon to PCB pad, brown on the RHS, red next left, orange next left, leaving spare pad on LHS. Connect green to any of the 3 pad grounds. Yellow wire take to component side & wire to the bottom connection of J2 with a 10K resistor in the hole as well.

8/ Power up & connect a noisy source & test the function of switch, making sure you don't short out anything. There should be fully anti-clockwise max noise reduction function with 8 steps to min, the ninth step is no noise reduction, step 10 is max reduction again. Then disconnect supply.

9/ Connect a bare solid wire to pin 14 of the LM380 IC (+12V reg) glue the DIL relay on top of this IC. Wire thick lead to relay coil, the other end of the coil wire to a PNP transistor emitter & also a diode anode. Wire the PNP base to the free end of the 10k (step 7). (Note step 13 when wiring to the relay.)

10/Change the LS cap C23 from 100uF to 470uF. Make sure it does not foul the pillar hole.

11/Wire up the PNP collector to the red LED & wire up the diode cathode to the green LEDs respectfully. Retest, the Red LED should only light on step 9 function, green otherwise.

12/Wire up the LS live connections via the relay to switch to through on power off. Picking up external input on bottom of input attenuator P1 r.h.s. R. (Note step 13 when wiring to the relay.)
Test that the relay puts LS signal though when the power is off & unit functions correctly when powered.

13/Assemble & checking nothing fouls. Test for LS magnet - relay interaction. If there is (e.g. not switching audio on power on/off) make a magnetic shield for the relay, e.g. cut & bend a steel lamination or tin can, to rap around the LS side of the relay. Also try a lamination strip shield taped to the LS magnet.

14/Make 2 wholes for an external LS 3.5mm jack sockets on the LHS by the upper & lower pillars leaving just enough room to clear the pillar but still clear the LS! Wire one up to up from the relay/Amp & 2nd to cut of off the LS.

See my Tech Bul on "Antenna Noise Canceller No 4", "Rig DC Power & RF Hazards".

Y don't U send an interesting bul?

73 de John G8MNY @ GB7CIP